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TRANSLATION

NUCLEAR WEAPONS AND PROTECTION FROM THEM

By

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FOREIGN TECHNOLOGY DIVISION

FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

WRIGHT-PATTERSON AIR FORCE BASE

OHIO

FOREWORD

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BY: I. Vlasov

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INTRODUCTION

Nuclear weapons were used for the first time by American imperialists in August 1945 with the bombardment of the Japanese cities Hiroshima and Nagasaki, as a result of which nearly three hundred thousand persons became victims of the monstrous crime of the ruling circles of the United States.

Issuing the command to use this weapon, the government of the United States pursued not only military but political aims. The atomic attack on Japan marked the beginning of a policy of blackmail and pressure on the Soviet Union.

Nurturing senseless plans of rocket-nuclear war against the socialist camps, the aggressive imperialistic circles developed a mad arms race, concentrating the main efforts on perfecting nuclear weapons and accumulating reserves. Based on the calculations of military experts, the contemporary world reserves of nuclear weapons can be considered as having, approximately, the power of 12.5 million such atomic bombs as were used by the Americans in Japan in 1945. The United States has conducted a large number of tests of nuclear ammunition in the atmosphere, under ground, and in space.

President Kennedy of the United States has openly discussed the preparation of the American command to develop initiative in the nuclear conflict with the Soviet Union, and Secretary of Defense MacNamara has admitted that in the 1962/1963 fiscal year the American military clique plans to spend almost 15 billion

dollars on nuclear weapons. Is more confirmation needed that the United States is increasing the nuclear arms race?

The Soviet Union conducts a peace loving policy, threatens no one, and plans to attack no one.

However, inasmuch as there exists the threat of releasing war by using means of mass attack, our country, for the purpose of guaranteeing its own safety, is forced to have contemporary powerful weapons, including even rocket-nuclear weapons which would allow us reliably to protect the interests of our native land and to ensure, when necessary, the destruction of any aggressor.

Contemporary nuclear weapons and rocket means of delivery erase the boundary between the front and rear and put under the eat of destruction any inhabited locality, at any distance from the border. The civil population in the first place will be the victim of rocket-nuclear weapons, but organized protection ahead of time can decrease human losses.

In order to exclude unnecessary victims, the Soviet people should develop a daily interest in the study of the destructive action of nuclear weapons, and also the means and methods of protection from it.

The present pamphlet is composed of material from the Soviet and foreign press. The author does not pretend an exhaustive and all-embracing illumination of all questions, but tries to expound briefly certain data about nuclear weapons and methods of protection from them.

The material in this pamphlet is designed for a wide circle of readers having an interest in questions of protection from weapons of mass attack.

1. General Characteristics of Nuclear Weapons

A nuclear weapon is a weapon of explosive action. It is based on the use of energy given out during various nuclear transformations. Depending upon the principles of the use of this energy three forms of nuclear ammunition are distinguished: atomic, thermonuclear, and hydrogen-uranium warheads.

All the energy of the explosion of atomic warheads is caused by fission chain reaction of atomic nuclei of heavy elements, for example plutonium or isotopes (varieties) of uranium.

Scientists have calculated that during fission of all atomic nuclei, 1 kilogram of the isotope uranium-235 will give off approximately the same energy content, as the explosion of 20 thousand aerial bombs weighing one ton each.

The explosive action of thermonuclear warheads is based on the use of energy, instantly given out during fusion reaction (joining) of the nuclei of light elements, for example isotopes of hydrogen — deuterium and tritium, under conditions of very high (several tens of million degrees) temperatures. This reaction is accompanied by a colossal energy release. It has been established that during a nuclear fusion reaction of a quantity of any weight of nuclei of light elements, 5 - 6 times more energy will be given off than during a nuclear fission chain reaction of a quantity of the same weight of nuclei of heavy elements.

Hydrogen-uranium warheads are based on the principle of using explosive

energy, given off as a result of the consecutive development of three nuclear reactions: nuclear fission of the atoms of heavy elements, nuclear fusion of light elements, and nuclear fission of natural uranium-238. Application in ammunition of a shell from natural uranium-238 allows us significantly to increase the power of nuclear explosion.

Destructive properties of nuclear ammunition in qualitative ratio are identical. The difference lies only in the power of the explosion, that is, the amount of injury inflicted.

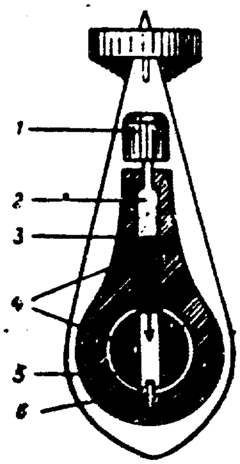
So that we may more clearly understand the phenomena occurring during nuclear explosion, we will become acquainted with the principal mechanism of certain nuclear ammunition.

As has already been said, at the basis of the action of ammunition with a nuclear warhead is a nuclear chain reaction occurring practically instantly and having an explosive character. This reaction appears during the influence of free neutrons on an atomic nucleus of uranium or plutonium, as a result of which the nucleus is divided initially into two fragments, giving off two or three free neutrons capable of causing the fission of other nuclei, etc. This leads to a nuclear chain reaction. The main parts of such ammunition are the atomic charge, the explosive mechanism, and the shell (housing). A nuclear chain reaction is possible only in the case where the mass of the atomic charge is equal or exceeds a definite magnitude called "critical". So that premature explosion does not happen, the charge is placed in the ammunition divided into several parts, each of which is less than critical and is located at a certain distance from the other.

To increase the development factor of the nuclear reaction, the parts of the charge are surrounded by special neutron reflectors.

The amount of atomic charge depends on type, material, construction, and can attain several kilograms.

For a nuclear chain reaction of an explosive character to occur it is sufficient with the help of a special explosive mechanism, to combine the parts of the charge into a single whole. As a result the mass of the charge will become more critical, and explosion will occur.



Fundamental diagram of the mechanism of a nuclear (atomic) bomb: 1) explosive mechanism; 2) ejection charge; 3) shell; 4) parts of the nuclear charge; 5) reflector of neutrons; 6) artificial neutron source.

The total weight of contemporary ammunition with a nuclear warhead varies from several hundred kilograms to several tons. The atomic bombs dropped in 1945 on Japanese cities weighed 4 - 8 tons.

Ammunition with thermonuclear warhead is a mechanism ensuring a practically instantaneous liberation of intranuclear energy. The main parts of such ammunition are the thermonuclear charge, nuclear charge, and shell (housing).

In contemporary ammunition lithium deuteride, which does not have critical mass is used as the thermonuclear charge.

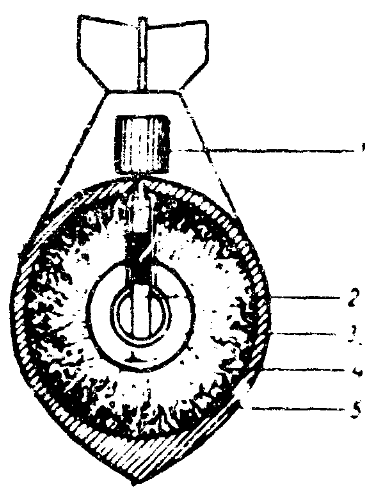
A fusion reaction of light nuclei now is possible only at very high temperatures measured at millions of degrees. Such temperatures can be attained only during an atomic explosion. Therefore, in the ammunition is placed an atomic charge which is the detonator — the exciter of the reaction. With operation of the atomic charge very high temperature is created, as a result of which in the thermonuclear charge fusion reaction appears, accompanied by liberation of the huge energy content.

The possibilities of liberating intranuclear energy in thermonuclear ammunition are theoretically unlimited. Therefore, they are significantly more powerful than nuclear ammunition.

The purpose of the shell (housing) is to promote fuller use of the charge. To increase the power of the charge at present, the shell can be made from natural uranium-238 which, under the influence of neutrons possessing very great speed and

energy, is able to enter into the nuclear reaction.

Nuclear charges can be of various power. The power of their explosive action is specified by the trotyl equivalent, that is the weight of a charge of ordinary explosive (trotyl), whose energy of explosion is equal (is equivalent) to the total energy of the explosion of a given nuclear warhead. Nuclear charges can have a trotyl equivalent from several tons, thousands (kilo) of tons to several million (mega-) tons.



Fundamental diagram of the mechanism of a thermonuclear (hydrogen) bomb: 1) explosive mechanism; 2) nuclear charge; 3) thermonuclear detonator; 4) thermonuclear charge (lithium deuteride); 5) shell.

Various types of ammunition can be equipped with nuclear warheads: aerial bombs, rockets, torpedoes, artillery missiles. Use of atomic and thermonuclear (hydrogen) aerial bombs and rockets with nuclear, thermonuclear warheads is most probable on objects in the rear.

In the United States, based on the power of explosion and purpose, nuclear ammunition is subdivided into tactical (power up to 20 kilotons), operational-tactical (from 20 to 100 kilotons), and strategic (power above 100 kilotons).

Sometimes it is possible to encounter conditional nuclear fission ammunition in three sizes: small (with a trotyl equivalent of 5 - 10 kilotons), average (20 - 50 kilotons) and big (more than 50 kilotons). In the equipment of the armies of the Nato countries there can be even more powerful ammunition.

Characteristics of a Nuclear Explosion

Depending upon the character and target of the attack, air, ground, underground, underwater, space, and other nuclear explosions can be carried out by the enemy.

To destroy cities and big industrial centers, the most probable are ground and air nuclear explosions. The external characteristic of air nuclear explosion consists of the fact that it occurs at a height of several hundred meters above the surface of land or water, and the fiery sphere appearing during the explosion does not touch the earth's surface. During ground nuclear explosion the fiery sphere touches the surface of earth on the largest possible area.

With the explosion of the nuclear charge (nuclear explosion), as a result of intranuclear reaction there occurs an instantaneous liberation of huge energy content, as a consequence of which the temperature in the zone of reaction attains tens of millions of degrees, and pressure is increased to billions of atmospheres. At the moment of air and ground explosion, due to the extraordinarily high temperature, a dazzlingly bright flash will be formed, which illuminates the site and the sky and is visible to many tens of kilometers. After explosion there will be formed a fiery sphere in the form of a ball or part of one, consisting of heated steam and gases. The glow of the fiery sphere, rapidly increasing in dimensions and lifting at great speed upwards, lasts for several seconds. Then the fiery sphere cools and turns into a swirling cloud, seizing dust from the surface of the land. For several minutes the cloud is connected with a pole of dust and obtains the mushroom-like form characteristic for nuclear explosion, attaining hugh dimensions (heights of 15 kilometers and more). Then the cloud gradually loses its form and is dispersed in the direction of the motion of the wind. Nuclear explosion is accompanied by a loud sound reminding one of thunder.

With ground explosion there is formed a fiery semi-sphere and in the center appears a large funnel, whose dimensions depend on the power of the nuclear ammunition.

With underground explosion, strongly heated gaseous products create a huge pressure on the ground which leads to its displacement and causes strong oscillations in the surface layer of earth, reminding one of an earthquake. At the place of explosion will be formed a funnel of huge dimensions.

Underwater explosion is characterized by the fact that, in the beginning, on the surface of the water, there appears a brightly luminescent spot, after which above the place of explosion there appears a water pole with a height of 1 - 2 kilometers. Above the pole will be formed a water cloud which can attain several kilometers in diameter. Approximately 10 seconds after the explosion particles of water start to fall and there will be formed basic waves*, surpassing ordinary waves by a height of 20 - 30 meters.

Space nuclear explosion occurs at such a height that the air density is practically equal to zero. A significant part of the energy of the explosion is radiated to surrounding space in the form of light, ultraviolet, infrared, and other waves. These waves can cause magnetic storms, as a consequence of which interference in radio and radar appears. The explosion of great power at a height of nearly 200 miles, performed by Americans on 9 July 1962 in the region of Johnston Island, caused significant disturbances of radio communications and radioactive contamination of outer space.

Applications of Nuclear Weapons

Nuclear ammunition can be used for inflicting blows on various targets and delivered to them by various methods.

Nuclear weapons can be applied not only for their effect on troops, but also for inflicting powerful blows on vitally important objectives located deep in the rear.

Nuclear weapons can be delivered to rear objectives with the help of aviation bombing and rocket technology.

*Basic wave — a thick fog of steam and small drops of water, possessing great radioactivity.

In the foreign press aircraft are indicated as probable carriers of atomic and thermonuclear bombs. Among their number are the heavy American strategic bomber B-52 "Stratofortress," which can deliver atomic and thermonuclear bombs of great power, weighing up to 10 tons, to distances of 5,000 kilometers from their base (its maximum speed of flight constitutes 1,000 kilometers an hour) the medium strategic bomber B-58 "Hustler," which delivers powerful thermonuclear bombs to a distance of 4,000 kilometers from their base with a maximum speed (during use of only turbojet motors) of 1,600 - 1,700 kilometers an hour and (during additional switching-on of rocket engines) 2,000 - 2,200 kilometers an hour. Modern means of anti-aircraft defense are able to reveal such aircraft on distant approaches to an objective and to wage successful combat by destroying them.

Therefore, considered more effective are pilotless means of delivering a nuclear charge to targets: winged missiles and especially ballistic missiles of medium and long range operation, including even intercontinental. For example, it is possible to bring an American rocket with nuclear warheads of medium range, the "Jupiter," which carries nuclear and thermonuclear charges with a power of 1 - 2 megatons to a distance up to 2,500 kilometers with an average speed up to 12 thousand kilometers an hour, or a "Polaris" rocket which can be launched from a submarine and carry a nuclear charge with a power of 300 kilotons up to 2,700 kilometers. For action at greater distances the American intercontinental ballistic rocket "Atlas" is intended, with a thermonuclear charge up to 4 megatons, with a range of more than 8,000 kilometers, and an average flight speed up to 20 thousand kilometers an hour.

Modern means of anti-aircraft defense present possibilities for detecting air targets at considerable distances. Therefore, in spite of the colossal speeds of rockets, not to mention winged missiles, carriers of nuclear charge, and bombers, they can be detected with a certain lead, allowing us, in good time, to inform the population to take measures of protection.

2. Destructive Effect of Nuclear Weapons

Nuclear explosions differ considerably from explosions of ordinary ammunition both in scale and also in the character of destructive effect. This is explained by the colossal quantity (almost simultaneously liberated during the explosion) of energy manifested in the form of shock wave, light radiation, penetrating radiation, and radioactive contamination. These forms of manifestation of the energy of a nuclear explosion are the destructive factors of a nuclear weapon. The simultaneous action of the shock wave, light radiation, and penetrating radiation determine the combined destructive effect of nuclear weapons on people. Furthermore, injuries to people are possible for a longer time after the explosion as a result of the effect of radioactive radiation in contaminated areas.

Let us consider more specifically the destructive properties of a nuclear weapon.

Shock Wave

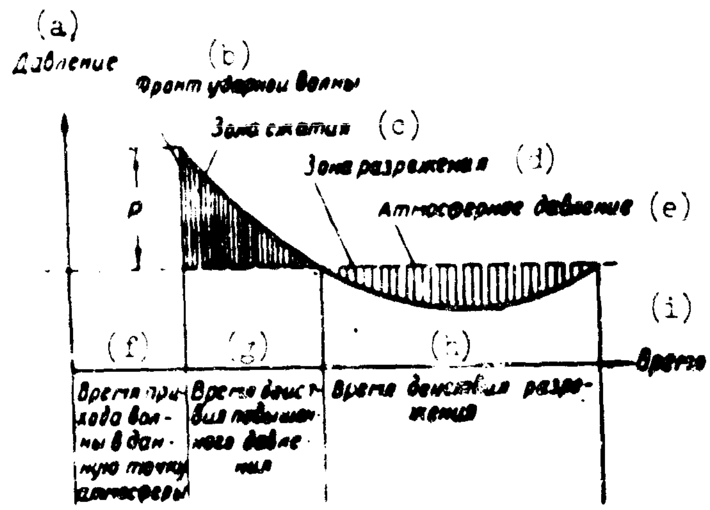
An air shock wave is formed as a result of a sharp increase in pressure and temperature in the boundary separating the fiery sphere of the nuclear explosion from its environment. It is a region of very strong mechanical compression (air, water), spreading with great speed to all sides from the place of explosion. On the shock wave is expended nearly 50% of all the energy of the nuclear explosion, which determines its principal value in the amount of injury inflicted as compared with other destructive factors of a nuclear explosion.

The shock wave of air and ground nuclear explosions consists of a zone of compression (where pressure is above atmospheric) and a zone of rarefaction (where pressure is sub-atmospheric).

Thus, any barrier encountered in the path of the motion of the shock wave experiences double effect: compression which attempts to overturn the barrier in

the direction of its motion, and rarefaction affecting the barrier in the opposite direction. Duration of the effect of the zone of rarefaction is approximately three times more than the time of effect of the zone of increased pressure.

In the path of its own motion the shock wave not only inflicts destruction, but grabs and carries with great speed fragments of destroyed buildings, sheets of iron, small stones, fragments of glass, etc.



Graph of pressure change in a shock wave.
KEY: (a) Pressure; (b) Front of shock wave; (c) Zone of compression; (d) Zone of rarefaction; (e) Atmospheric pressure; (f) Time of arrival of wave at a given point of atmosphere; (g) Time of increased pressure effect; (h) Time of rarefaction effect; (i) Time.

The destroying force of the shock wave is determined by the amount of its excess (above atmospheric) pressure, which is measured in kg/cm^2 and $tons/m^2$.

Maximum excess pressure is observed in front of the shock wave, then with passage of the front it gradually diminishes.

During airburst of nuclear ammunition with a power of 20 kilotons excess pressure attains in the epicenter 3.5 kg/cm^2, at a distance of 1 kilometer — 1 kg/cm^2, at a distance of 2 kilometers — 0.3 kg/cm^2.

An important element characterising the shock wave is the period of its effect on a given object, measured, depending upon the power of the explosion, from several tenths of a second to several seconds.

With an increase in distance from the place of explosion the time of its effect is increased.

The speed and distance of propagation of the shock wave, and also its destroying force depend on the form and power of the nuclear explosion, the planning of the inhabited localities, the site's relief, and other factors. Near the place of nuclear explosion the speed of propagation of the shock wave several times exceeds the speed of sound; as distance increases from the place of the explosion it falls fast. Thus, with an airburst of nuclear ammunition with a power of 20 kilotons the shock wave attains a point 1 kilometer distant from the place of explosion after 2 seconds, 2 kilometers after 5 seconds, 3 kilometers after 8 seconds.

Along the path of its motion the shock wave affects buildings and structures and inflicts various types of damage.

During the explosion of the atomic bombs above the cities of Hiroshima and Nagasaki (power of 20 kilotons) was observed the full destruction of all ground buildings and structures at a distance of 1 kilometer, severe damage at a distance of 2 kilometers, light damage at a distance of 3 kilometers, and destruction of glass at a distance of 8 - 10 kilometers from the place of explosion.

The greatest destroying force of the shock wave is manifested in reference to objects raised above the surface of the land. Multi-story buildings and structures are subjected to greater destruction than buildings with only a few stories.

Less durable to the effect of the shock wave are wooden buildings, especially the frame type. During the explosion of the atomic bomb in Hiroshima wood-frame homes were destroyed up to 3 kilometers from the place of explosion. At the same time reinforced concrete buildings with durable metallic frames did not receive significant damages even 270 meters from the place of explosion.

Structures sunken in the earth are subjected to significantly smaller effects of the shock wave than those above ground. Having a known influence on the character of shock wave effect are site relief and green plants. Behind the reverse

slopes of elevations the pressure of the shock wave is smaller than on a level site. In Nagasaki located in the hills, the destruction of city buildings was in a significantly smaller area than in the city of Hiroshima located on a level site.

A peculiarity of the shock wave is its ability to flow in closed locations not only through windows and doors, but also through small holes and slots. This leads to the destruction of partitions and equipment inside a building and to injuries of people in them.

During an airburst the general area of destruction and damage to ground buildings and structures will be greater than during ground burst, but the destruction during ground explosion will be significantly stronger.

Unprotected people can perish or receive various injuries (breaks, contusions, damage to internal organs, etc) from the direct effect of the shock wave. In the cities of Hiroshima and Nagasaki injuries of medium severity from the effect of the shock wave were observed in a radius up to 2 kilometers from the place of explosion. People more strongly endure the direct effect of the shock wave than ground buildings. Injury to unprotected people appears during excess pressures exceeding 0.4 kg/cm^2 and full destruction of major stone buildings during excess pressures exceeding 0.3 kg/cm^2, while partial destruction of buildings occurs during excess pressures exceeding 0.1 - 0.2 kg/cm^2, etc.

However, the shock wave can inflict injury on unprotected people not only as a result of its direct effect, but also by indirect means (fragments of destroyed buildings, flying lumps of ground, pieces of iron, fragments of glass, and other objects.) The indirect effect is especially dangerous in inhabited localities where wounds of people by all kinds of fragments are possible at significant distances.

Severe wounds of the inhabitants of Hiroshima and Nagasaki by fragments of buildings were observed at a distance of 2 kilometers from the epicenter of the explosion, but from the direct effect of the shock wave at a distance of 750 meters.

With increase in the power of nuclear explosions, the distances at which the hock wave causes definite destructive effect increase approximately with the following dependence: with a 10-fold increase in power, the radii of zones of destruction increase 2.2 times; with an increase in the power of explosion 125 times, the radii of destruction increase 5 times, etc.

The destruction and injury caused by the shock wave appear in a large area. However, in all cases, the area of regions where all ground buildings are completely destroyed and protective structures damaged constitute an insignificant part (3 - 6%) of the total nuclear striken area.

From this certain practical conclusions can be made. Ground buildings and structures are not able to protect people from the shock wave. The best shielding from the shock wave is furnished by underground structures.

Using the natural features of the relief, green cultivation, and other massive barriers far from buildings, it is possible to a significant measure to weaken the effect of the impact pressure (the motion of air behind the front of the shock wave).

The shock wave spreads considerably more slowly than light. A man noticing the flash of the explosion can manage to cover himself. The greater the distance from the place of explosion, the longer the time available to occupy a shelter or simply to lie on the ground and decrease the danger of injury by the shock wave.

Light Radiation

The main source of light radiation is the fiery sphere of the nuclear explosion whose effective glow, depending upon the power of charge, lasts from one to tens of seconds. 30 - 40% of all the energy of the nuclear explosion goes into light radiation. In its strength, the light radiation considerably exceeds solar radiation on a clear day. Therefore, in spite of the briefness of the action, it is able to inflict serious injury. During ground explosion the effectiveness of injury by light radiation is approximately half as much as during air burst, since

approximately half the energy is expended on melting the ground. Furthermore, in the air much dust is lifted, which shields the luminescent region of the explosion.

Appearing during light radiation are visible (ultraviolet) and invisible (infrared) rays able to inflict burns of various severity on unprotected people and animals, to cause temporary loss of sight, and also to be one of the causes of mass fires.

The main characteristic of the destructive effect of light radiation of a nuclear explosion is the light pulse. It is determined by the quantity of light energy falling on one square centimeter of illuminated surface for all the time of glow of the fiery sphere. Light pulse is measured in calories per square centimeter of surface.

The magnitude of light pulse depends on the form and power of the nuclear explosion, the distance from the place of explosion, the state of the atmosphere at the moment of explosion, and other factors.

The magnitude of light pulse during airburst of a nuclear bomb with a power of 20 kilotons attains at the place of explosion 130 cal/cm^2, at a distance of 500 meters 75 cal/cm^2, at a distance of 1 kilometer 35 cal/cm^2, etc.

Effecting people outside a shelter, light radiation can cause burns and carbonisation of integuments. The degree of burns depends on the magnitude of light pulse. Thus, a first degree burn, characterised by the reddening of skin, is caused by a light pulse equal to 2 - 4 cal/cm^2. A second degree burn appearing during a light pulse of [illegible] - 10 cal/cm^2 is characterised by the formation of blisters. A third degree burn accompanied by the formation of sores and necrosis of skin appears during a light pulse of 10 - 15 cal/cm^2.

With a big light pulse carbonisation occurs of exposed parts of the body. Light radiation sets fire to various objects and materials and leads to the formation of strong fires at a significant distance from the center of the nuclear explosion. However, also causing mass fires in the nuclear striken area can be the

damage and destruction of heating stoves, gas-piping systems, short circuits of torn electric lines, and others.

During the explosions of the atomic bomb in the Japanese cities of Hiroshima and Nagasaki nearly 50% of all injured suffered mainly from light radiation and fires. With this, severe burns of exposed parts of the body were observed up to 1.5 kilometers from the place of explosion, light burns up to 4 kilometers, mass fires in a radius of 2 kilometers. During the explosion of powerful thermonuclear ammunition light radiation may cause mass injuries of people at great distances.

The character of burns from light radiation for people depends on the color of clothes, thickness of the material from which they are made, and the tightness of fit to the body. Clothes of light tones, especially white, reflect a large part of the light pulse, while dark absorbs and, consequently, inflames faster. It has been established that people dressed in clothes of a dark color will receive burns approximately twice as severe as those who have on light colors.

Burns most frequently occur on the face, neck, hands, and other exposed parts of the body. Considering that light radiation spreads rectilinearly, it is possible to say that burns are observed only on sections of the body, turned in the direction of the explosion.

Blinding usually is observed for people who look in the direction of the explosion, but it has, as a rule, a temporary character.

Light radiation does not penetrate through opaque objects and materials. Therefore, any shelters, as well as objects creating shadow, can completely or partially protect one from its effect. A number of timely fire-fighting measures will allow us to decrease the danger of propagation of fires.

Penetrating Radiation

Penetrating radiation is a flow of radioactive radiation, spreading to all sides from the place of explosion. Appearing during nuclear explosion, the invisible

radioactive rays (neutron flux and gamma rays) possess the ability to penetrate through various barriers and to exert harmful biological effects on living organisms, as a result of which radiation sickness can appear.

The character of the destructive effect of radioactive radiation is estimated by the cumulative dose of radiation, received by the organism for all the exposure time. The dose of irradiation in a unit of time is called the power of the dose. It is measured in roentgens per hour.

The degree of injury depends not only on the received dose of irradiation, but also on the condition of the organism.

It is considered that a person during his life can, without harm to his health, receive, in all, considerable irradiation in small doses. Permissible dose for a working day is 0.05 roentgen; for a week, 0.3 roentgen. With simultaneous irradiation the maximum permissible dose can not be more than 50 roentgens; a dose of 100 roentgens is harmful for the health.

During a nuclear explosion the magnitude of the cumulative dose depends on the form and power of the explosion, the distance from the place of explosion, and other factors.

During airburst of a nuclear bomb with a power of 20 kilotons, under conditions of an open site, the dose of irradiation constitutes, at a distance of 600 meters, 10 thousand roentgens; at a distance of 1,000 meters, 1,000 roentgens; at a distance of 1,500 meters, 100 roentgens; etc.

With increase of distance from the place of explosion the radiation dose decreases tens of times.

Radiation sickness can develop only after receiving a dose of radiation above that permissible. There are three forms of radiation sickness: light, medium, and severe.

The light form of radiation sickness appears with a dose of irradiation of 200 - 300 roentgens. Its external characteristics develop only after several hours.

Then there sets in a period which is characterised by a satisfactory condition of the patient. After two to three weeks there is observed an increase of temperature, vomiting, diarrhea, and loss in weight. The main characteristics of radiation sickness are weakly expressed. After medical treatment work capacity is completely restored.

Radiation sickness of the medium type appears with a dose of irradiation of 300 - 400 roentgens. It is characterised by the fact that the external characteristics of the illness develop during 4 - 5 days, after which sets in an insidious period of imaginary well-being. After it the illness enters its progressive stage which lasts two to three weeks. Then, a gradual recovery can set in.

The severe form of radiation sickness appears with a dose of irradiation of more than 400 - 500 roentgens and sets in immediately after irradiation. Sharp headaches and a depressed state are observed. One to four hours after irradiation can start nausea, vomiting, diarrhea, and increased temperature. The insidious period will be absent altogether or pass very quickly. Radiation sickness of the severe type, in many cases, ends in death.

On the penetrating radiation is expended approximately 5% of all the energy of the nuclear explosion. The destructive effect of penetrating radiation continues for 10 - 12 seconds after the explosion. The number of fatal injuries from the effect of penetrating radiation in Hiroshima and Nagasaki was from 5 to 15% of the total number of injured. From penetrating radiation died unprotected people up to 800 meters from the place of explosion. Up to 1,200 meters the number of cases dangerous to life reached 50%, but more than 2,000 meters from the explosion dangerous cases of injury from penetrating radiation were not observed. With an increase in the power of nuclear ammunition the danger of injury from penetrating radiation increases.

Protection from penetrating radiation is based on the abilities of various materials to weaken the intensity of radioactive radiation. The more durable the

material and the thicker its layer, the more reliably it will protect. For example, twice weakened is the effect of penetrating radiation during passage through a layer of concrete 10 centimeters thick, a layer of earth 14 centimeters thick, a layer of wood 25 centimeters thick. People who are in shelters at the moment of explosion will receive a significantly smaller dose of radiation than those outside shelter at the same distance.

Buildings, structures and various objects are not affected harmfully by penetrating radiation. However, it may cause artifical (induced) radioactivity for certain elements in the composition of the soil.

Radioactive Contamination of Site

The effect of the shock wave, light radiation, and penetrating radiation is limited by several seconds at distances measured in the tens of kilometers.

Radioactive contamination is another matter, occurring as a result of the falling of radioactive substances both in the region of the explosion, and also along the path of motion of the so-called radioactive cloud.

Sources of radioactive area contamination are fallout substances in the form of fragments, nuclear fission of the charge, remainders of unseparated parts of the nuclear charge and induced radioactivity of the soil, appearing as a result of neutron flux.

The special danger of radioactive contamination consists of the fact that it contaminates sites not in the region of explosion. The radioactive cloud lifts from earth dust mixed with radioactive substances. It attains several kilometers in radius and moves in the direction of the motion of airflows at a height of 10 - 20 kilometers. Along the path of the cloud radioactive substances from it fall to earth, contaminating the site, air, various local objects, water, provisions, etc. The so-called "path" of the radioactive cloud stretches to great distances from the place of explosion (several hundred kilometers).

The degree of area contamination with respect to the radioactive "path" depends on the form and power of the explosion. the meteorological conditions, and other causes. With an airburst it is small; with a ground burst, greater. With the ground explosion of thermonuclear ammunition, performed by the Americans in the region of Bikini Island in the Pacific Ocean in March 1954, radioactive dust affected Japanese fishermen at a distance of 160 kilometers from the place of explosion. Contamination of radioactive dust was observed also on vessels 1,600 kilometers from the place of explosion.

Radioactive substances, falling from a radioactive cloud, are able to preserve their destructive effect from several hours to several months. Stability of sections of radioactive contamination will basically depend on the properties of the radioactive substances. Certain external conditions, for example meteorological, can affect the degree of contamination. Wind carries radioactive substances, but rain washes, lowering thereby the degree of contamination.

Unprotected people and animals in the region of radioactive contamination can be subjected both to external, like penetrating radiation, and to internal irradiation if radioactive substances together with contaminated air, food, or water get inside the body. Internal irradiation is much more dangerous, since as a result of it radiation sickness can appear.

Protection of people from radioactive contamination is based on the protection of the breathing organs from internal irradiation and the exposed parts of the skin from external irradiation, from radioactive substances hitting them.

It is necessary also to consider certain specific peculiarities of radioactive substances. They do not have any external characteristics and it is possible to detect them only with the help of special radiation monitoring instruments. Radioactive decay cannot be stopped or accelerated by any kind of means or methods. Therefore, decontamination of the contaminated (by radioactive substances) surfaces of the site and objects can be performed only by mechanical removal.

Brief Characteristics of a Nuclear Striken Area

The territory subjected to the effect of a nuclear weapon together with the buildings and structures in it, is called a nuclear striken area. A nuclear striken area possesses a number of characteristic peculiarities. The great destructive force peculiar to nuclear weapons leads to the creation of a large area of destruction. The simultaneity of the effect of several destructive factors will form the most varied injuries and damage.

The character and dimensions of the nuclear striken area depend not only on the power and form of the nuclear explosion performed, but also on the relief of the site of the inhabited locality, its planning, and others.

Under the effect of the shock wave of the nuclear explosion in the inhabited localities there will appear massive destruction and damage to buildings and structures, mains, power systems, and bridges, as well as obstructions to streets and roads. In the foreign press are presented suppositional data, describing the zones of destruction in a nuclear striken area. From these data it appears that the radius of the zone of complete and severe destruction will constitute, with a ground explosion of nuclear ammunition with a power of 100 kilotons, nearly 2.5 kilometers, but with a 10 megaton explosion — nearly 8 kilometers (respectively, in area, 20 and 200 kilometers square). The general dimensions of the striken area with a 100 kiloton explosion attain a radius of 10 kilometers, and with a power of 10 megatons — 32 kilometers (respectively, in area, 320 and 3,200 kilometers square). For the external boundary of the striken area we take the boundary of the damage to buildings and structures. Consequently, destruction in the nuclear striken area carries a massive character and embraces a huge territory. However, the area of heavy destruction constitutes approximately 5–6% of the total dimensions of the nuclear striken area.

In the nuclear striken area mass fires appear. The strongest areas of fire are created beyond the limits of the zones of heavy and strong destruction. In

regions with smaller destruction separate spots of fire and area fires appear, which gradually move along the inhabited locality and, depending upon the density of building and other factors, can develop into "fire storms." Intense fires in Hiroshima and Nagasaki appeared in a zone, 3 - 5 kilometers from the place of explosion. In Hiroshima the fires developed in a "fire storm", while in Nagasaki this was not observed. This is explained by the differences in the relief of the sites. In the opinion of foreign specialists, with a 10 megaton explosion the main zone of fires appears approximately in a zone 5.5 - 16 kilometers from the center of the explosion, and the boundary of strong fires in a radius approximately up to 25 kilometers. The character of radioactive contamination in the nuclear striken area will be very nonuniform. The strongest contamination, especially with a ground burst, will be observed in the center of the explosion. The region of contamination will have the outline of an irregular circle, stretched in the direction of the wind. A large part of the fallout falls along the path of motion of the radioactive cloud and contaminates sites far from the nuclear striken area, in regions of so-called radioactive contamination.

Both in the nuclear striken area and in regions of radioactive contamination, a gradual drop in levels of radiation will occur. The majority of the territory 2 - 3 days after explosion will become safe for rescue work, since by then the quantity of decays on it will be less than the permissible dose. In a certain, comparatively small part of the territory contamination will be stabler.

The presence of great destruction, fires, and contamination will considerably complicate efforts to put an end to the consequences of nuclear attack.

3. The Main Principles of Organizing Protection From Nuclear Weapons

Guarding the peaceful labor of the Soviet people stand the Soviet Armed Forces. At the XXII congress of the Communist Party of the Soviet Union N. S. Khrushchev said: "The advances of socialist production, Soviet science and technology have made it possible to carry out the present revolution in military matters.

Our country and the whole socialist camp now presents a mighty force, which is fully sufficient to protect reliably the conquest of Socialism from the encroachment of imperialistic aggressors".

In a historically short period a fine new technical material base has been created for arming the army and the fleet with the most modern military technology. Advances in industry have allowed us to introduce into military matters the latest achievements of automation and electronics, rocket technology, and atomic energy.

Chief in the development of the Soviet Armed Forces is the creation in them of rocket troops with a strategic purpose, which are in constant combat readiness. They are able to inflict a crushing blow on any aggressor. Soviet rocket construction releases more and more advanced and mighty rockets. Soviet scientists and engineers have created global rockets, which can carry multi-megaton nuclear warheads to any point on the globe. They are able to accomplish flight around earth and are invulnerable to the anti-missile defense of an enemy. In our country nuclear charges of super power have been created and successfully tested. Tests of new forms of rocket-nuclear weapons, conducted recently, immeasurably increased the combat might and combat readiness of our Armed Forces. According to the apt expression of N. S. Khrushchev, now, when imperialists consider the question of unleashing war, over their heads will always hang, as a sword of Damocles, the Soviet 50- and 100-megaton bombs.

According to the views of foreign military specialists, contemporary war can start with sudden blows from the air on the deep rear. In the first days and even minutes of the war not only the capitals of the countries will be attacked from the air, but also big administrative centers, industrial regions, located even at great distances from national boundaries. Therefore, the Soviet Armed Forces, on which is placed the problem of the direct protection of the country from a rocket-nuclear attack, are always ready to repel a surprise attack of an enemy and to wreck his criminal projects.

An extremely important role in the prevention of a sudden blow on rear area objectives is played by the air defense of the country, whose basic task is to detect the air enemy (aircraft, rocket) and to destroy it in air. The timely detection of the air enemy will make it possible to warn the population ahead of time of the danger of attack from the air, which is extraordinarily important for organizing protection.

To protect the country from air attack, air defense troops are situated, with modern means of combat, which are able to strike reliably any air target and to battle hostile rockets. Along with first-class anti-aircraft rockets, troops of anti-aircraft defense are equipped with contemporary supersonic fighter-interceptors which have powerful armament and good radar, as well as other equipment which ensures them reliable detection and guidance to air targets under any conditions. Troops of anti-aircraft defense of the country are in constant combat readiness, vigilantly carrying out their combat duty.

However, it would be deeply erroneous to conclude that the presence even of the most advanced means of detection and destruction of the air enemy completely guarantees us from threat of attack from the air. Means of attack from the air in the most important imperialist states are on a rather high level of development. The expenditure of huge resources on the further improvement of a means of nuclear weapon delivery to rear area objectives proves that the threat of attack from the air with nuclear weapons actually exists. Therefore, realization of measures to be undertaken for the protection of the population from weapons of mass destruction is one of the main elements of preparation for the country's defense. The fulfillment of this task is placed on civil defense, representing a system of government activity for the protection of the population from the effect of weapons of mass destruction.

One of the main tasks of civil defense is the timely announcement to the population and the objectives of the national economy of the threat of attack from the air. The successful solution of this complicated (especially in the case of

rocket armaments) problem will allow us good time to undertake measures of protection which, in turn, to a significant degree will lower the loss and destruction.

Direct protection of the population from injury by a nuclear weapon is the central problem of civil defense. A very important place in the solution of this problem is occupied by the preparation of means of protection ahead of time, but to organise protection only by collective means of protection (refuges, shelters) is impossible. The best method of protection from nuclear weapons is the timely dispersion of people and materials beyond the limits of big cities. Realisation of such measures will allow us to a significant degree to evacuate big cities and, consequently, to reduce many times the possible victims.

Successful solution of the problem of civil defense, in many respects, depends on advance preparation of wide sections of the population for protection from weapons of mass destruction. With this aim, at places of work and residences instruction of the population is organised concerning the means and methods of protection from weapons of mass destruction and also the activities necessary to counteract the consequences of the air attack. Direct preparation of the population is conducted by the organisations, the Voluntary Society to Assist the Army, Air Force, and Navy (DOSAAF) and the Union of the Societies of the Red Cross and the Red Crescent (SOKK and KP).

The guarantee of uninterrupted work for objectives of the national economy, under threat of attack, is attained in the first place by accomplishing, ahead of time, technical and other measures of civil defense.

Use by the enemy of nuclear weapons can lead to a complicated situation. It is necessary, in a limited time, to conduct rescue and urgent emergency restoration work (urgent emergency restoration work is that which should facilitate rescue operations) which will demand summoning a large quantity of prepared and trained people.

To fulfill the tasks of counteracting the consequences of enemy attack, from

the workers and employees of a given enterprise, institution, or school, and also from tenants of apartment houses, are formed special non-military civil defense organizations: units, teams, groups, sections, etc.

The role of civilians in the nonmilitary civil defense organization is most important as a method of attracting the attention of wide sections of the population to the solution of practical problems of civil defense, and, consequently, the problems of strengthening the defense of the relics of our native land.

4. Means and Methods of Protection From Nuclear Weapons

Recently published were the recollections of one Japanese physician who rendered aid to the victims of the atomic bombardment in Hiroshima. He writes:

"...In the city terrifying panic reigned; streets were heaped with corpses, in the middle of which, staggering maimed maddened, naked people, their clothes burned off their skin peeled in strips, hair fallen. But most disgusting and mean was the fact that the people who doomed Hiroshima to these tortures did not notify their victims what, precisely, they would strike them with."

At present we know not only how nuclear weapons strike, but also how to protect ourselves from them. There exist various collective and individual means of protecting people from nuclear weapons.

Collective Means of Protection

People in streets, yards and other places during enemy attack will suffer not only from the effect of the shock wave, light radiation, and penetrating radiation accompanying nuclear explosion, but also from radioactive substances and fragments of construction, destroyed buildings, etc.

Collective means of protection are the best protection: refuges and all forms of shelters.

In cities with large and dense population there are special refuges, in which

large groups of people can be sheltered. These shelters possess high protective properties. They have a strong protective construction (walls, coverings) which is designed to sustain the effect of the air shock wave of the nuclear explosion. Depending upon the relief of the site, the groundwater level, and the type of building materials, a refuge can be solid (monolithic), laminar, or underground. Shelters of the solid type have reinforced concrete walls and coverings with a thickness of several meters, they are constructed below ground level. With a high groundwater level such shelters can protrude above ground. Shelters of the laminar type usually are completely sunk in the ground. They have thinner protective safeguards in construction and from above are protected by special reinforced concrete or a concrete slab, on which lies a layer of ground. Underground shelters are located deep underground. The layer of ground above this construction ensures the required protection from the shock wave of the nuclear explosion. Internal equipment of all the listed shelters ensures the possibility of a long stay in them.

Basement shelters (built-in) are also a sufficiently reliable means of protection of the population. They furnish protection from the effect of the shock wave of a nuclear explosion (at some distance from the center or epicenter of the explosion), light radiation, and penetrating radiation, and also radioactive substances and other means of injury. These refuges are located in basements of apartment buildings and are convenient for fast occupancy by the population at any time of the day at the signal "Air alert". For a basement refuge to give great protection, it should be completely in the ground; the covering should be durable and able to sustain the effect of the air shock wave, and in the case of destruction of the building, to sustain the weight of the collapsing parts of the building.

When there are no basements in buildings, or when basements do not correspond to the technical requirements, near apartment or industrial buildings, specially constructed, are separate shelters. They are made from reinforced concrete or brick with reinforced concrete covering and completely or partially sunk in the

ground. The protective properties of separately standing shelters are approximately the same as basement shelters.

During a nuclear explosion of great power only those shelters which are near the epicenter or center of the explosion are destroyed. At a distance from the place of explosion the effectiveness of a protective means of shelter will increase. The total area in which shelters can be completely or partially destroyed constitutes approximately more than 5% of the total area in which unprotected people will perish or be injured.

Shelters are hermetically sealed, that is, they are insulated from the flow of external air. This is necessary so that contaminated air does not penetrate inside. Modern shelters are equipped, taking into account requirements of protection from nuclear weapons, and have no less than two entrances and an emergency exit. Protected by a metal cover, the emergency exit is located at a definite distance from the building so that when the building is destroyed it will not tumble. Such planning decreases, at the same time, injury to those sheltered in case of partial destruction of the refuge; it ensures rapid filling of the refuge, and, when necessary, fast and safe evacuation from it.

In the entrance vestibule are steel or reinforced concrete protective-hermetic and hermetic doors. The emergency exit is equipped with the same shutters. Doors and shutters with the help of edging rubber and special tension mechanisms are tightly pressed to the opening and ensure its hermetic sealing.

For a constant flow of fresh air inside the shelter there is a filter-ventilation system.

In order that the shock wave not penetrate through the air-safeguarding device inside the shelter, special wave quenchers are established.

If the hermetic sealing of the refuge is done reliably, then after closing all doors and manholes and starting the filter-ventilation unit the air pressure inside the shelter will be somewhat higher than outside. There are formed so-called

supports increasing the reliability of the hermetic sealing. By the amount of support we judge the quality and condition of the shelter's hermetic sealing.

In the shelter are created everyday conditions medically hygienic; it is equipped with illumination, central heating, a water line, sewerage, and benches and plank-beds are set up. All this is necessary in order to ensure conditions for a long stay in the shelter, especially when, due to avalanches, the exit is hampered or the site around the refuge is so strongly contaminated that the exit before appropriate treatment cannot be used.

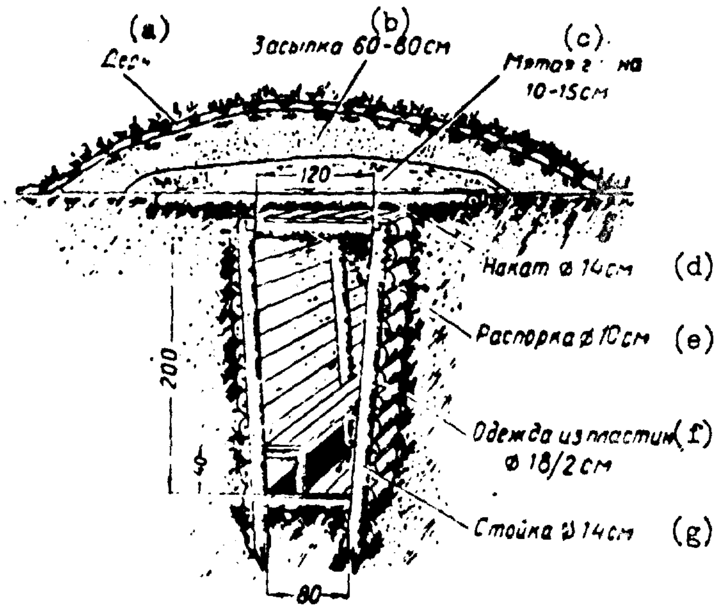
The refuge should have a fire-fighting capability, tools for emergency rescue work, a reserve of clay, sacking, and wire for stopping up cracks in the walls, a medicine chest, decontamination means, a reserve battery, or kerosene lanterns, and candles.

Emergency tools are intended so that those sheltered could emerge under their own strength, from their covered shelters.

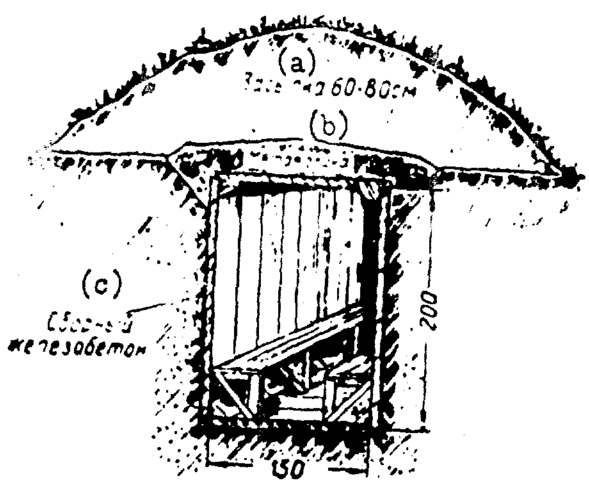
All refuges should be constantly ready for use, supplied with all the necessary property and inventory, kept clean, and have free entrances.

One of the main collective means of protection in small cities and inhabited localities in rural areas are shelters of various types of construction: sunken, semi-sunken (trench, dugout), underground (gallery). All of them ensure the protection of people from the destructive effects of a nuclear explosion and in the first place, from the threat of contamination by radioactive substances along the path of the radioactive cloud. The effectiveness of shelters is obvious from the following example.

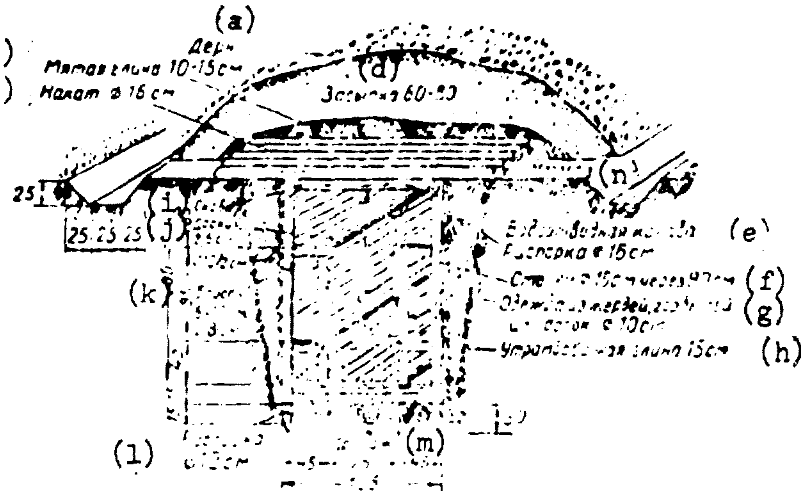
Wood and earthen shelters, built in the cities of Hiroshima and Nagasaki for the protection of the population from ordinary aerial bombs, turned out to be comparatively stable to the effect of the atomic explosion. At a distance of 275 meters from the epicenter of the explosion more than half of such shelters were preserved while apartment buildings were destroyed at a distance of 1,500 - 1,800 meters.



Simplest wood and earthen shelter.
KEY: (a) Sod; (b) Filling 60 - 80 cm; (c) Kneaded clay 10 - 15 cm; (d) False ceiling, diameter 14 cm; (e) Distance Bar, diameter 10 cm; (f) Plate lining, diameter 18/2 cm; (g) Upright, diameter 14 cm.



Shelter with a reinforced concrete panel struct
KEY: (a) Filling 60 - 80 cm; (b) Kneaded clay (c) Reinforced concrete panels.



Dugout

KEY: (a) Sod; (b) Kneaded clay 10 - 15 cm; (c) False ceiling, diameter 16 cm; (d) Filling 60 - 80; (e) Drainage ditch. Distance Bar, diameter 16 cm; (f) Upright diameter 16 cm through 90 cm; (g) Lining from poles, slabs, or boards, diameter 10 cm; (h) Stamped clay 15 cm; (i) Brace; (j) Boards 2.5 cm; (k) Bar; (l) Distance Bar; (m) Drainage; (n) Ground level.

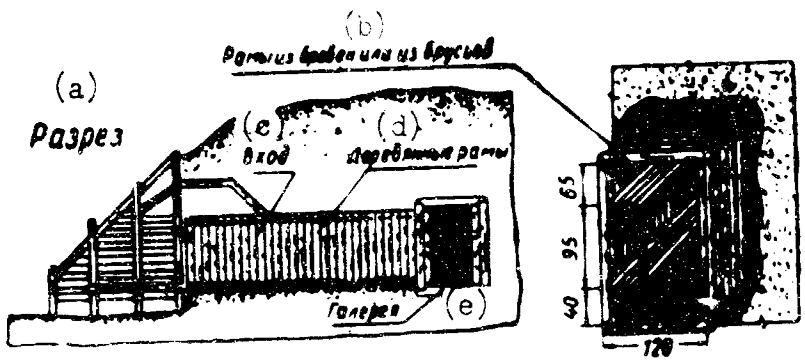
Ordinary shelters are narrow trenches covered from above, designed for 20 to 80 persons.

The selection of construction and the type of shelter depends, in the first place, on the ground conditions, groundwater depth, site relief, and building materials. For example, in a case where the groundwater depth is lower than 2.5 meters from the surface, sunken shelters are built, but with a higher level of groundwater semi-sunken shelters are built.

Underground shelters (gallery) are built in the steep slopes of ravines, precipices, and shores of rivers, without opening the upper layers of the ground. For that, sections with dry stable ground are selected.

The protective thickness of the ground above the shelter (gallery) should be no less than 3 meters. Before the entrance into the gallery there is a protective wall.

Shelters, as a rule, are constructed by the population under leadership of building specialists in predetermined places. In order that shelters not ·umble,



Gallery.
KEY: (a) Cut-away view; (b) Frames out of logs or beams; (c) Entrance; (d) Wooden frames; (e) Gallery.

they are erected at a distance from the surrounding buildings, equal to half the height of these buildings, plus 3 meters, but in all cases no nearer than 7 meters. Shelters cannot be located near storehouses with fuel, electricity, mains, sewerage, gas, water lines, electric high tension lines, and also flooded sections. It is best of all to build a shelter in sections free from buildings (vacant areas, boulevards, large yards, and kitchen gardens).

For building one should select a dry raised place, located as near as possible to the usual place of residence.

For bracing the walls of the shelters boards, wattle, cane, brushwood, brick, or other available materials can be used. With an absence of necessary building material it is possible to pull apart cheap wooden structures.

For a roof use logs, ties, poles, over which pack a layer of kneaded clay 10 - 15 centimeters thick, and then a layer of ground 60 - 80 centimeters thick.

The covering can be flat, arched with brushwood, bound together with cane or brushwood. In woodless regions it is possible to use sand bags. For the equipment of shelters various reinforced concrete parts are also useful: beams, slabs, and panels. Shelters of reinforced concrete rings possess high protective properties.

Along the floor of the shelters is built a drainage canal connected with a water-collecting well located at the entrance. Entrance into the shelter is made gradually. At the entrance is a vestibule with wooden doors. To increase the period of service, wooden structures before installation are processed with resin or other preservative compositions and for protection from fires are covered with fire protective plaster or paint.

In the shelters there are benches for sitting and plank-beds for lying down. A place is provided for the installation of stoves, ventilation equipment, and tanks with water. For the toilet there is assigned a special niche which is separated by a partition. For illumination kerosene and electric lanterns or candles can be used.

To protect the people from radioactive substances the shelter is hermetically sealed. For this all slots in the construction pieces are thoroughly stopped up and as far as possible filled, and the door is equipped with tension locks. Inside is the simplest filter-ventilation equipment.

In the absence of refuges and shelters, especially under the conditions of a surprise enemy air attack, it is possible to use for protection various sunken structures, natural features and various green cultivation. It is possible to be covered on slopes of heights turned in a direction from the center of the city or the nearest big industrial objective. In woods, parks, squares, and gardens, one should not shelter oneself in the middle of big trees. It is safest to be sheltered on the edges or in sections covered by shrubs or young trees. In parks and on boulevards it is possible to use low barriers, walls of fountains, and stumps of big trees for shelter.

Various sunken structures, such as basements, tunnels, and underground passages, can be used for protection only if their covering is sufficiently durable to sustain fragments of buildings collapsing above them or near them, if they are fireproof, and if they ensure the possibility of getting out of them with rubble above.

When necessary, the covering of these structures are strengthened by additional columns and boxbeams, unnecessary door openings and windows are filled, and the location is equipped with everything necessary.

In the absence of protective structures it is possible to seek shelter in ditches, pits, drains, recessions of railroads and highways, foundations and trenches dug for the foundations of buildings or for laying water lines and other mains.

It is possible to seek shelter in basements. In basements with windows one should be nearer to the walls, but not opposite the windows. When necessary it is possible to seek shelter in the first stories of stone and other durable buildings, using for protection staircases with reinforced concrete flights or interior principal walls. If it is necessary to seek shelter near walls, one should lie down, face to wall, at a separating wall, or below windows.

Individual Means of Protection

Important to the protection of people, along with collective methods, are individual methods, protecting the organs of breathing, the eyes, the face, and all the surface of the body from the entry of radioactive substances inside an organism and contamination by them of the body. Individual means of protection are prepared by industry. However, for protection it is possible to use also the simplest available means of protection. The most reliable means of protecting the organs of breathing, the eyes, and the face from radioactive substances is a filtering gas mask. The protective action of such a gas mask is based on the principle of filtration, that is, purification of contaminated air from radioactive substances in the internal layers of the gas mask canister. Due to this, under the mask (face part) of the gas mask proceeds the necessary pure air. During a forced long stay in a contaminated atmosphere radioactive substances will be stored in the gas mask canister and it can become a source of radioactive radiation. Therefore, to increase the operational period of the filters in the gas mask canisters various replacement protective filters are developed, and at home it is possible to prepare cases from flannel or baize. Protective filters and cases increase the protective power of the gas mask. The facing part of the gas mask, prepared from rubber, serves for bringing air, purified in the gas mask canister to the organs of breathing, and also for the protection of the eyes and face from radioactive substances. Furthermore, the facing part weakens the effect of light radiation on the skin of the face.

Our industry makes gas masks for adults and children. For protection of the smallest children (infants) special children's protective sets are made. Gas masks guarantee reliable protection only with correct selection (necessary size), skillful application and use in various conditions. Therefore, it is necessary systematically to check correctness of fit of gas masks in gas fumigation chambers and to conduct gas mask training.

In the absence of gas masks, for the protection of the organs of breathing from radioactive dust it is possible to use respirators, used in various enterprises for protection from industrial dust, and also various dressings (for example, cotton-gauze) and masks (filter masks, anti-dust masks), which the population can make.

Cotton-gauze dressing is made from a piece of gauze and a layer of cotton (thickness 1 - 2 centimeters)designed so that dressing tightly covers the bottom of the chin, the mouth, and the nose to eye depressions. For protection of the eyes one should put on anti-dust spectacles.

To make a filter-mask it is necessary to take 10 - 12 layers of gauze and to sew them in the form of a mask, covering the chin and face along its frontal part. Holes for eyes are covered by a celluloid plate, which is glued to the gauze.

The anti-dust mask is prepared from 4 - 5 layers of fabric: an upper layer (tight layer of coarse calico or linen), 2 - 3 internal layers (broadcloth, flannelette, or wool) and a lower layer (a fabric not contaminated when moistening). These materials are cut, then sewed, and to them bracing is sewed. Glass for the eye holes will be cut from glass, plexiglas , or celluloid.

In an extreme case, for protection of the organs of breathing from radioactive substances it is possible, temporarily to use a towel or handkerchief formed in several layers, and also cotton and gauze tightly pressed to nose and mouth.

Improvised means of protecting the organs of breathing are intended only for brief protection. Therefore, those using them, should, as fast as possible emerge from the region of radioactive contamination as directed by the local organs of civil defense. If the situation is not clear, then it is better to use the nearest shelter until receiving orders from the civil defense posts.

To protect the surface of the body from the effect of radioactive substances individual means of protecting the skin are used. As a rule, the population does not have special means of protection (coveralls and protective suits). Therefore, it is necessary to use for this purpose improvised (home-made) means of protecting

the skin -- ordinary clothes. The population can independently prepare, from unbleached linen or other closely woven cloth (for example, oilcloth), a protective cloak with a hood and protective stockings, which are put over ordinary clothes. Also it is possible beforehand to adapt clothes for purposes of protection. The best of all for the masculine worker to use are athletic or school suits (jackets and trousers) or the standard quilted jacket. To guarantee they are airtight, it is necessary to prepare additional attachments: breastplates, hoods, and side clasps of trousers.

In the absence of a(prepared beforehand) home-made means of protection from radioactive substances, it is possible to use ordinary cloaks, raincoats, overcoats, and cotton jackets. For the best protection of the skin, clothes should be buttoned on all hooks and buttons; the collar should be lifted and tied by a scarf, gloves should be on and ends of sleeves tied with twine or cord. Women should don trousers, children, best of all, should be carried in arms, wrapped in a blanket or sheet.

To protect legs rubber boots, overshoes and galoshes are used. In an extreme case it is possible to wrap the legs in tarpaulin, oilcloth, sacking or thick paper. Even wooden or plywood boards attached to the soles give a certain protection when passing through a contaminated area.

All these methods ensure only a brief protection.

But if we quickly and skillfully use the available means of protection, then it is possible to weaken significantly the degree of effect of radioactive substances on the organism.

5. Main Obligations and Rules for the Behavior of the Population Under Nuclear Attack

To a significant degree the success of protection from nuclear weapons depends on the behavior of the population under attack from the air, as well as skillful and correct actions in the striken areas, in contaminated areas, and also when counteracting the consequences of nuclear attack.

The character of the actions of citizens under nuclear attack depends on the complications of the situation and is determined by signals and orders of civil defense.

Rules of behavior and action of the population on signals of civil defense and in the striken areas are determined by special resolutions of executive committees of Councils of Deputies of workers and by order of civil defense headquarters.

In these resolutions, the texts of which are published in the press, there are transmitted, by local broadcast networks and released in the form of separate announcements, clearly defined obligations of citizens with respect to personal protection, and the priority and order of carrying out warning (lowering the destructive effect of nuclear weapons) measures are established, as well as the means of supplying civil defense signals and the order of action based on these signals.

Protective measures of civil defense include fire-preventive, anti-epidemic, and medical-hygienic measures. They are conducted in all enterprises, establishments, educational institutions, and all apartment houses.

By order of the organs of civil defense the population should participate in building and equipping shelters

The earthwork of a shelter must be completed in the shortest possible period since a full profile trench already can be, to some degree, used for protection.

In each apartment fire-fighting measures should be conducted. All areas in apartment houses should be cleared of inflammable objects, and gas lines, electrical appliances, and heating systems should be in good condition.

Loudspeakers and radios should be constantly on, since orders and directions of civil defense will be transmitted by radio.

It is necessary to make for all members of the family, and constantly keep convenient for fast use, individual means of anti-gas protection.

If it is not possible to purchase or obtain gas masks, it is necessary to prepare cotton-gauze dressings and anti-dust masks. Also it is necessary to make

protective cloaks, protective stockings and mittens, and to obtain bandaging material. If directives of civil defense are followed, all individual means of protection and bandaging materials one should constantly have on hand.

It is very important to prepare beforehand a two-to-three day reserve of food and water. Food, documents, and bandaging materials should be packed in a special bag or rucksack and constantly on hand.

All objects, which can during a nuclear explosion inflict wounds (table lamps, pictures, etc.), it is necessary to remove; soft furniture and other objects of everyday home use should be kept in standard covers or covered with some kind of cloth. Such order one should maintain daily in the dwelling.

All citizens must accurately execute the orders of civil defense. In particular, all orders transmitted in connection with the evacuation of children, patients, aged, and disabled citizens from big cities will be strictly executed.

Decisions concerning evacuation made by the organs of Soviet power, will be transmitted to citizens by relayed broadcast, television, announcements, and the press, as well as at their places of work. The order will indicate who is subject to evacuation, the location of assembly points and the embarkation of transport, routes of evacuation, what is permitted to be taken as baggage, where and to whom to turn in case of difficulty.

As soon as the order is given in the city (or the signal is passed) to evacuate, every citizen subject to evacuation should immediately check whether his neighbors heard this signal, then quickly get ready and head to the assembly point. Upon arrival at the assembly point it is necessary to register and to await further orders.

Arriving at destination point, evacuated citizens carry out a corresponding registration at the reception places of the evacuated population and solve there all problems connected with distribution, life, and labor.

During evacuation citizens have to manifest a high awareness and observe

steadily the established order. They are obliged to execute all orders of chiefs of echelons, workers of the militia, and other persons responsible for carrying out the evacuation.

With the appearance of a direct threat of nuclear attack from the air the signal "Air alarm" will be passed. The signal "Air alert" is given by blowing whistles of all sound media for 2 - 3 minutes, and also by relayed broadcast. At enterprises and establishments it is duplicated by local means. Time for carryi[illegible] out measures for this signal will be limited (only several minutes), therefore it is necessary to act fast and dexterously.

The main problem will lie in organization, observing the strictest disciplin[illegible] abandoning the location without panic, and getting to shelter. But before abandon[illegible] the location, it is necessary to dress quickly, extinguish fires in furnaces, extinguish primuses and oil stoves, turn off gas systems and electric heater applia[illegible] close air vents, windows, take prepared rucksack or bag, then close door and head to the nearest refuge or shelter. If on the street during the signal "Air alarm, one should execute orders of policemen on duty and civil defense wardens who will indicate the location of the nearest refuges or shelters. If the signal "Air ale[illegible] comes at work or in a public place, one should take protective measures directed [illegible] the administration.

It is necessary even in peacetime to study the location of entrances to re[illegible] and the way to them. When filling shelters there should be no commotion and di[illegible] order.

It is the duty of everyone to help children, invalids, and aged g[illegible] quickly [illegible] the shelters. To guarantee order when filling shelters and the obser[illegible]nce of [illegible] of behavior in the refuges, the civil defense formation sets out speci[illegible] posts. [illegible] is the obligation of each one sheltered to occupy a place in sections [illegible]ly on or[illegible] of the duty officer and to help him maintain order.

In the refuge (shelter) it is necessary to take reserve provision[illegible] water, individual means of protection. It is prohibited to take domestic animals, inflammable

and sharp smelling substances. In the refuge one should conduct oneself calmly, not making abrupt and unnecessary movements. It is prohibited to smoke and, without permission of the commandant, to light kerosene lamps and candle, i.e., this worsens the composition of the air. All sheltered are obliged to execute directives of the duty officer and give him aid. Even during actual severe circumstances one should remain calm and not panic.

During contamination of the inhabited locality by poisoning and radioactive substances, and also bacteriological agents the signal "Chemical attack" is sent out with the help of sound means (whistles of factories for 1 - 2 minutes in the form of a series -- one long and one short) and by relayed broadcast. With air attack using nuclear weapons this signal does not go out since the nuclear explosion itself is considered, simultaneously, as the signal "Chemical attack".

Rules of behavior and the action of the population, to a significant degree, depend on where they are surprised by this signal.

If, for any reason, people remain outside shelter or are in shelters not equipped for gas defense they should immediately put on gas masks, cloaks, stockings, or other means of protection and emerge from the contaminated region.

If people are in refuges, then they continue to remain in place, executing the orders of the commandant. The duration of stay in refuges in these cases depends on the external situation and the condition of the refuge.

If shelters are in contaminated territory, the population does not abandon them until receiving the order from civil defense headquarters. When the hermetic sealing is disturbed, all sheltered have to put on individual means of protection.

Necessity can arise for taking the people from refuges and equipped shelters even in the case when the site around the shelter is contaminated, decontamination work has not been conducted (during threat of avalanche, flooding, or flowing of gas inside the compartment), and the exits of the refuges are heaped up. In this case one should use the emergency exit. The order of exit and the rules for using the emergency exit will be reported to those sheltered, by the commandant. It is

necessary to help the aged and children emerge, especially during movement along a gallery and the rise through the shaft of the emergency exit.

The emergency exit may also be blocked or it may not be. In this case, using an emergency tool, the sheltered themselves under the leadership of the commandant take measures to clear the obstructions or to make a new exit.

Before abandoning the refuge, it is necessary to put on individual means of protection and to cover all exposed sections of the body.

After exit from refuges one should observe the rules of behavior in contaminated territory and accurately execute directives of the civil defense posts. The least infraction of the rules may cause injury.

If civil defense has checked and designated boundaries of the contaminated area, then during movement it is necessary to follow warning signs and to move only along shown routes and passages. In the absence of signs it is necessary to act independently.

In order to reduce the time of stay in contaminated areas, move quickly (but do not run), trying not to lift dust. If the path lies through a park, boulevard, or garden, one must not touch branches, leaves, or grass, since on them falls radioactive dust and remains a long time. If the region is greatly destroyed, one should move in the middle of the street since additional crumblings and cave-ins of buildings are possible.

If through the contaminated region move a group of people, it is necessary to observe intervals so that dust from those in front does not fall on those behind. It is necessary to remember that in the contaminated region one must not sit, lean, kneel down, or lie down, since here everything can be contaminated. In no case should one smoke, eat, drink, or remove gas mask and other means of protection. It is forbidden to enter buildings or to take any objects in the contaminated territory or location.

When moving one must watch that all the surface of the body is covered. Gloves should not be removed to repair cloaks, stockings, etc, with the bare hands. It is

necessary to render possible help to the injured, children, aged, invalids, and the sick.

After leaving the contaminated area and, in certain cases, even in the contaminated territory, it is necessary to produce partial medical treatment and disinfection of clothes and footwear. If washing points are already developed and working, then civil defense will direct the population to the posts for full medical treatment.

After leaving the region of radioactive contamination all citizens go through radiation monitoring and other forms of special inspection.

As has already been said above, a serious threat to the population are radioactive substances falling from the region of the radioactive cloud at a great distance from the place of nuclear explosion. Concerning the approach of the radioactive cloud the population is informed by a special signal, which is given by the same means as the signal "Chemical attack," or by those methods determined by the organs of civil defense in the locality.

The main protective measure in the zone of radioactive contamination will be the shelter and protection of the people in the locality. The best means of protection are refuges and shelters equipped with anti-gas defense.

In their absence can be used dugouts, cellars or basements. It is possible to be protected in apartment houses and other buildings. All these shelters significantly weaken the effect of radioactive radiation (a dugout by 100 - 150 times; a ditch with a covering, by 40 times; a stone house, by 10 - 15 times; and a wooden house, by 3 - 5 times). In the simplest shelters it is necessary to use means of protection for the organs of breathing.

The length of stay in the shelters and the further behavior of those sheltered will depend, in the first place, on the character of the contamination in the territory.

The territory through which the radioactive cloud passes is conditionally divided into two zones: the zone of brief, temporary contamination dangerous to

unprotected people for 2 - 3 days, and the zone of steady contamination dangerous for a longer period.

In regions of brief contamination, constituting a large part of the contamination belt, people, after the levels of radiation drop to permissible norms, abandon shelters and continue to work and live in the former place. In regions of steady contamination the behavior of citizens should be otherwise. After staying in shelters for several days it will be necessary on the order of the civil defense organs to abandon them and, in an organized manner, to emerge or to depart for uncontaminated regions, observing main rules for getting out of contaminated regions.

In a number of cases, as a measure of protection, emergency evacuation will take place from regions, which will threaten the danger of contamination along the route. However, similar measures of protection are not always applicable, since to evacuate people completely, especially from regions where there are important industrial objectives, will not always be possible.

The signal "Air alert" can come unexpectedly before carrying out warning and protective measures of civil defense. This means that enemy rockets or aviation have disturbed the air space of our native land, and the city can be subjected to a nuclear blow at any minute.

The action of the population under conditions of a suddenly given signal "Air alert" will be complicated. But even in these, very complicated conditions one should act in an organized manner and without panic. Knowledge of the destructive properties of a nuclear weapon and the skill to use the simplest means and methods of protection have an extremely important value for the preservation of life to a significant number of people.

It is necessary, as fast as possible, to abandon buildings and to seek shelter in the nearest refuge, basement, or any other shelter. Considering the possibility of a stay in contaminated areas, it is necessary to take a raincoat, overcoat, sheet, galoshes, overshoes, and other things, which can be used for purposes of individual protection.

If in any public place, one should not panic and rush to doors, but should calmly listen to the directives of the administration and act in accordance with them.

On the outskirts of the city use any possibility to abandon the city quickly on foot or in any incidental machine.

If the signal "Air alert" is given in a locality and the citizens do not manage to flee, it is possible to recommend the use of basements of buildings as shelters. If basements have windows, one should stay nearer the walls, but not opposite the windows. In the absence of basements it is possible to be sheltered in the first stories of stone buildings, using for protection staircases with durable reinforced concrete flights or interior principal walls. If it is necessary to shelter oneself near exterior walls, it is necessary to lie with face to wall, to a separating wall, or below the windows.

If a nuclear explosion occurs while on the street, one should waste no time on a search for refuges and shelters, but one should use stone barriers, fountains, and other durable barriers for protection.

Even if such shelters are lacking, one can run to the middle of the street, quickly lie face down, cover legs and hands by a protective cloak, and remain motionless for 10 - 20 seconds after the explosion.

On the outskirts of the city and in a rurual site it is possible to use for protection natural features and certain artifical structures. Even a slight depth in a site possesses certain protective properties. For example, narrow winding ravines, quarries, trenches, pits, ditches and others, offer protection from the shock wave. Heights with steep slopes, deep ravines, creating a shadow, offer protection from light radiation and

If there is no shelter, lie down on the ground.

penetrating radiation. As shelters it is possible to use pipes under embankments, embankments themselves, and hollows.

Shelter in a ditch and behind a fence during an explosion of an atomic bomb.

Forests and parks strongly lower the destructive effect of the shock wave and light radiation. The radii of striken areas of the shock wave in forests, as compared with open sites, are reduced approximately 1.5 times, and light radiation 3 times. In woods, parks, and gardens it is necessary to be in sections covered by shrub or young trees. Large trees can inflict injury on people from broken boughs and falling trunks.

While executing these recommendations, one should know that sunken structures and site relief can be used only for brief protection from the effect of shock wave, light radiation, and, partially, from the penetrating radiation of the nuclear explosion. 20 - 30 seconds after burst one should leave the striken area, observing fixed rules of behavior.

With nuclear explosion in inhabited localities there can be a significant number of injured. All of them will need emergency medical help. Delay can have severe consequences.

Therefore, the timely and correct rendering of first aid is the duty of all the adult population. It is necessary also to remember that those citizens, uninjured and able to work, can be summoned to the job of counteracting the consequences of nuclear explosion. Therefore, all should be prepared to fulfill rescue and other works in the striken area, both independently, and within the nonmilitary civil defense organisation.

Conclusion

A nuclcar weapon is a powerful weapon and with its use the zone of destruction will include extensive territories and a large quantity of the population. Before the might of nuclear weapons we are not powerless. To guard the sacred boundaries of our native land stand the valiant Armed Forces of the Soviet Union, equipped by first-class technology. Along with the further improvement of active methods of combatting the rocket-nuclear weapons of the enemy it is necessary to carry out more widely special measures for the protection of the population. These measures are quite effective and can decrease loss and injury.

The active participation of all the population in measures of civil defense is a matter of great national importance. Civil defense is a national matter since it pulls into the orbit of its activity, without exception, all the population of our country, wherever they live. Civil defense is a great, humane matter; it is preparing the multi-million population of our country for active protection from weapons of mass destruction.

Therefore, all forms of participation of the population in measures of civil defense have to be daily developed, including such as daily study and a deepening of knowledge concerning protection from nuclear weapons.